Contracting Officer Workload and Contingency Contracting: Evidence From the Department of Defense

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Monterey, California. Naval Postgraduate School

NPS-AM-12-C9P25R03-095

EXCERPT FROM THE

PROCEEDINGS

OF THE

NINTH ANNUAL ACQUISITION RESEARCH SYMPOSIUM THURSDAY SESSIONS VOLUME II

Contracting Officer Workload and Contingency Contracting: Evidence From the Department of Defense

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Published April 30, 2012

The research presented at the symposium was supported by the acquisition chair of the Graduate School of Business & Public Policy at the Naval Postgraduate School.

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Preface & Acknowledgements

Welcome to our Ninth Annual Acquisition Research Symposium! This event is the highlight of the year for the Acquisition Research Program (ARP) here at the Naval Postgraduate School (NPS) because it showcases the findings of recently completed research projects—and that research activity has been prolific! Since the ARP's founding in 2003, over 800 original research reports have been added to the acquisition body of knowledge. We continue to add to that library, located online at www.acquisitionresearch.net, at a rate of roughly 140 reports per year. This activity has engaged researchers at over 60 universities and other institutions, greatly enhancing the diversity of thought brought to bear on the business activities of the DoD.

We generate this level of activity in three ways. First, we solicit research topics from academia and other institutions through an annual Broad Agency Announcement, sponsored by the USD(AT&L). Second, we issue an annual internal call for proposals to seek NPS faculty research supporting the interests of our program sponsors. Finally, we serve as a "broker" to market specific research topics identified by our sponsors to NPS graduate students. This three-pronged approach provides for a rich and broad diversity of scholarly rigor mixed with a good blend of practitioner experience in the field of acquisition. We are grateful to those of you who have contributed to our research program in the past and hope this symposium will spark even more participation.

We encourage you to be active participants at the symposium. Indeed, active participation has been the hallmark of previous symposia. We purposely limit attendance to 350 people to encourage just that. In addition, this forum is unique in its effort to bring scholars and practitioners together around acquisition research that is both relevant in application and rigorous in method. Seldom will you get the opportunity to interact with so many top DoD acquisition officials and acquisition researchers. We encourage dialogue both in the formal panel sessions and in the many opportunities we make available at meals, breaks, and the day-ending socials. Many of our researchers use these occasions to establish new teaming arrangements for future research work. In the words of one senior government official, "I would not miss this symposium for the world as it is the best forum I've found for catching up on acquisition issues and learning from the great presenters."

We expect affordability to be a major focus at this year's event. It is a central tenet of the DoD's Better Buying Power initiatives, and budget projections indicate it will continue to be important as the nation works its way out of the recession. This suggests that research with a focus on affordability will be of great interest to the DoD leadership in the year to come. Whether you're a practitioner or scholar, we invite you to participate in that research.

We gratefully acknowledge the ongoing support and leadership of our sponsors, whose foresight and vision have assured the continuing success of the ARP:

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- Director, Acquisition Career Management, ASN (RD&A)
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- Office of the Assistant Secretary of the Air Force (Acquisition)
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We also thank the Naval Postgraduate School Foundation and acknowledge its generous contributions in support of this symposium.

James B. Greene Jr.
Rear Admiral, U.S. Navy (Ret.)

Keith F. Snider, PhD
Associate Professor

Panel 25. Contemporary Acquisition Issues

Thursday, May 17, 2012	
3:30 p.m. – 5:00 p.m.	**Chair: Harry Hallock,** Deputy Director, Army Contracting Command ***Applying the Three C's of Sustainable Development to Defense Department Planning*** Elliot Maltz, *Willamette University* ***Past Performance as an Indicator of Future Performance: Selecting an Industry Partner to Maximize the Probability of Program Success*** James Bradshaw and Su Chang *The MITRE Corporation* ***Contracting Officer Workload and Contingency Contracting: Evidence From the Department of Defense*** Patrick Warren and Nancy Huff *Clemson University*

Harry Hallock—Mr. Hallock became deputy director of the U.S. Army Contracting Command (ACC), a major subordinate command of the U.S. Army Materiel Command (AMC), on October 3, 2011. ACC, headquartered at Redstone Arsenal, AL, includes two subordinate commands, the Mission and Installation Contracting Command and the Expeditionary Contracting Command; and six major contracting centers that support AMC's other major subordinate and life cycle management commands. ACC provides global contracting support to warfighters through the full spectrum of military operations. ACC consists of more than 5,800 military and civilian personnel worldwide who awarded and managed nearly 198,000 contractual actions valued at an estimated $86.8 billion in fiscal year 2011.

Mr. Hallock previously served as executive director of the ACC Contracting Center in Warren, MI. As the senior civilian procurement authority, he also advised the Tank-Automotive and Armaments Command (TACOM) Life Cycle Management Command (LCMC) commanding general on the total acquisition process, including policy development, compliance and review, contract pricing, contract management, and associated support.

At ACC-Warren, Mr. Hallock oversaw warfighting readiness for the Soldier by providing contracting and acquisition support for combat and tactical vehicle systems, deployment and Soldier support equipment, and armament. He directed more than 800 civilian and military personnel located at six separate geographic sites and who administer more than $119 billion in active contracts. Since fiscal year 2007, the contracting center has executed more than 113,536 contract actions totaling $100.2 billion in obligations. Mr. Hallock was responsible for contracting offices located at Rock Island Arsenal, IL; Anniston Army Depot, AL; Red River Army Depot, TX; Sierra Army Depot, CA; and Watervliet Arsenal, NY; as well as the headquarters in Warren, MI.

Mr. Hallock was appointed to the senior executive service on May 13, 2007. Before his appointment, he served as the associate director for operations, and prior to that as chief of the research and development (R&D) and the installation support contracting division in Warren, MI.

Mr. Hallock holds a bachelor's degree from the University of Delaware in Newark, DE, and a master's degree from the Naval Postgraduate School in Monterey, CA. He is Defense Acquisition Workforce Improvement Act Level III certified in Contracting, Program Management and Logistics. Mr. Hallock has received the Department of the Army Achievement Medal for Civilian Service and the Department of the Army Commander's Award for Public Service.

Contracting Officer Workload and Contingency Contracting: Evidence From the Department of Defense[1]

Patrick Warren—Warren is an assistant professor of economics at Clemson University and received his PhD in economics from MIT in 2008. He studies the economics of organizations, with a focus on decisions in public-sector and non-profit organizations. [patrick.lee.warren@gmail.com]

Nancy Huff—Huff is a PhD student in economics at Clemson University, graduating in May 2012. She works in industrial organization, focusing on procurement and subcontracting. In the summer of 2012 she is joining the Institute for Defense Analyses. [nmvogh@gmail.com]

Abstract

This paper investigates the relationship between endogenously incomplete contracts and the selection of procurement terms. We take advantage of variation in the workload of Department of Defense (DoD) contracting officers to estimate the relationship between contractual incompleteness and procurement outcomes, such as the use of competitive acquisitions procedures and the risk of renegotiation. In a sample of 4.6 million contracts from 32 DoD procurement offices over six years, increases in the cost of writing complete contracts led to decreased reliance on competitive acquisition procedures, increased reliance on firm-fixed-price contracts, increased risk of renegotiation, and increased total costs of procurement. Although the effect of limited acquisitions capacity on contingency contracts in Iraq and Afghanistan has generated a lot of concern recently, we find that, if anything, these contracts are a little less responsive to workload. The DoD's acquisitions manpower has not kept up with the exceptional growth in the level of acquisitions contracting over the past decade. This paper clarifies some of the potential economic consequences of the resulting increase in workload faced by DoD contracting officers.

Introduction

Defense contracting is characterized by a high level of uncertainty due to unpredictable changes in both technology and demand. Writing and managing well-specified contracts in this uncertain environment is necessarily time consuming; contracting officers must allocate their limited time-budget among the contracting tasks at hand. If contracting officers' responsibilities expand to include additional tasks, then they must decrease the average amount of time spent on each task, constraining them to leave some potential eventualities unaddressed. In this paper, we investigate how changes in the workload of contracting officers relate to the equilibrium level of contractual completeness and the use of other procurement terms, including award type, pricing structure, the use of competition, the probability of renegotiation, and the final price paid.

After briefly outlining the procurement process in the Department of Defense (DoD), we review a model from Warren (2012) that extends Bajari and Tadelis (2001) to understand how varying workload affects the choice of contractual completeness and contractual terms. This model predicts that busier contracting officers write less complete contracts, so the risk of renegotiation increases as fewer contingencies are fully specified. The increased need for contract modifications raises the cost of using fixed-price contracts, so higher workload causes contracting officers to shift to more flexible cost-plus contracts. The higher risk of renegotiation also means that the benefit of competitive acquisitions falls because competition only identifies the most efficient contractor for the original contract specification. As a result, the model predicts that busier contractors shift to less competitive acquisitions procedures. All of these individual effects of higher workload—higher risk of renegotiation,

[1] JEL Classification: D23, D82, H11, H57.

reduced use of fixed-price contracts, and reduced use of competitive acquisitions procedures—increase the expected price of any given project.

In line with this model, we analyzed a sample of 4.6 million contracts from a panel of 32 DoD procurement offices over the years 2005–2010. Consistent with the model described in Warren (2012), we found that exogenous increases in contracting officer workload that increase the cost of contractual completeness decrease the use of competition, increase the probability of renegotiation, and increase the total costs of procurement. Curiously, we found that higher workload increases the use of firm-fixed-price contracts. In addition, we found that higher workloads induce contracting officers to use more delivery orders (calls on an existing contract) and fewer new definitive contracts.

One subset of procurement that has received a lot of attention in recent years is contingency operations in Iraq and Afghanistan. The congressionally appointed Commission on Wartime Contracting in Iraq and Afghanistan (CWC; 2011) estimates that between $31 2 billion and $60 billion were lost to waste and fraud in Iraq and Afghanistan. In their report on wartime contracting, the CWC (2011) attributes part of this waste and fraud to an insufficient number of acquisitions personnel, stating that "agencies continue to lack sufficient staff and resources to enable adequate management of all aspects of contingency contracting." In light of these concerns, we separately examined the impact of changing workloads on a subsample of contracts procured in Iraq and Afghanistan. We found that higher workloads do have important implications for the procurement terms of these contingency contracts, but the effects on contingency contracts are not dissimilar to the effects of increased workload on the remainder of (non-contingency) contracts. In fact, with the exception of competition, changes in workload have a lesser effect on the procurement terms for contracts performed in Iraq and Afghanistan than they do for other contracts. Hence, the personnel problems for Iraq and Afghanistan contracts identified by the CWC may be even more important for the domestic procurement policy of the DoD.

The acquisitions community has expressed concern about the growth of contracting straining the capacity of the acquisitions workforce. The DoD's procurement obligations have increased from $270.7 billion in FY2005 to $367.7 billion in FY2010, a 36% increase over these six years.[2] In contrast, the DoD's contracting workforce grew from 26,025 in FY2005 to 29,792 in FY2010—an increase of only 14% over the same six-year period.[3]

Moreover, relative to the DoD civilian workforce as a whole, the civilian acquisitions workforce has a disproportionate share of employees near or at full retirement eligibility.[4] The acquisitions community worries that the increasingly strained contracting workforce will be unable to adequately specify and manage contracts, leading to increased susceptibility to fraud, reduced bargaining power in negotiations, and excessive dependence on private contractors. Rau and Stambersky (2009) report that less than 15% of surveyed senior contracting officers at the Army Contracting Command believed that there were sufficient acquisition management positions in their installation, and only 23% believed that contractor performance on service contracts received the proper level of oversight. The Report of the Acquisition Advisory Panel to the Office of Federal Procurement Policy and the U.S. Congress (Acquisition Advisory Panel, 2007), Chapter 5, stated that "inadequacy in the acquisition workforce" wastes government resources and produces unsatisfactory

[2] FPDS-NG (available at www.usaspending.gov).
[3] FY10 Defense Acquisition Workforce Summary Data (available at https://dap.dau.mil/workforce/Pages/Default.aspx).
[4] See Gates, Keating, Jewell, Daugherty, Tysinger, Robbert , and Masi (2008) for a complete analysis of these trends in the DoD acquisitions workforce.

contractual outcomes.[5] We address these concerns in this paper and provide evidence for the consequences of limited contracting capacity on acquisitions outcomes.

In addition to addressing a relevant policy question, this paper also contributes to the academic literature on incomplete contracting. Most of the existing literature, summarized in the Determinants of Procurement Terms section of this paper, either treats the level of completeness as exogenous or identifies exogenous differences in the inherent complexity of projects that shift the cost of contractual completeness. In this paper, we follow the approach introduced by Warren (2012), taking advantage of variation in the workload of contracting officers as a shifter of the cost of contractual completeness to estimate the relationship between contract specificity and the selection of contractual terms. Our results are generally consistent with those of Warren as well as the broader literature.

In the rest of this section, we put the paper in context, both in terms of the existing literature and the policy environment. In the section A Model of Procurement, we review the model from Warren (2012) that predicts the effects of workload on contractual completeness and procurement terms. In the Data and Methodology section, we discuss the data and the empirical approach. In the Results section, we present our empirical results, and in the Conclusion, we present our concluding remarks.

Determinants of Procurement Terms

For a summary of economics literature on the determinants of contractual form, see Lafontaine and Slade (forthcoming). Several papers have investigated the determinants of the specific features of procurement contracts examined here. The general approach taken in this paper, where contractual completeness is endogenously determined and, in turn, affects the other contractual provisions, was pioneered by Goldberg (1977) and formalized by Bajari and Tadelis (2001). The particular techniques employed here were first applied in a modified form to civilian agencies by Warren (2012).

This framework has been used to investigate the decision to open a contract to competition, often couched in terms of "auctions versus negotiations." Several papers look at how the use of competitive procurement methods is affected by differences in completeness driven by the underlying difficulty of the project. In the context of private construction contracts, Bajari, McMillan, and Tadelis (2008) found that more complex projects are procured less competitively and, holding complexity fixed, competitive procurements are more likely to be renegotiated. Gil and Oudot (2008) found similar results in the context of French defense procurements, at least within a given buyer-seller relationship, as did Leffler, Rucker, and Munn (2007), in the context of private timber sales. Warren (2012) took a different approach, looking for differences in completeness induced by exogenous variation in the opportunity cost of the contracting officer's time due to changes in workload, and found that in civilian agencies of the U.S. federal government, higher workloads decrease the use of competition. We extend Warren's analysis to DoD agencies and contingency contracts in Iraq and Afghanistan, in particular. We found that increasing workload decreases the use of competitive acquisitions procedures; this effect is even larger for procurement in Iraq and Afghanistan.

[5] See also the large body of work by the GAO: *High-Risk Series: An Update* (GAO-05-207, January 2005); *DoD Acquisitions: Contracting for Better Outcomes* (GAO-06-800T, September 2006); *Contract Management: DoD Vulnerabilities to Contracting Fraud, Waste and Abuse* (GAO-06-838R, July 2006); *Defense Acquisitions: Assessments of Selected Major Weapon Programs* (GAO-06-391, March 2006); *Defense Acquisitions: DoD Has Paid Billions in Award and Incentive Fees Regardless of Acquisition Outcomes* (GAO-06-66, December 2005); *Defense Management: DoD Needs to Demonstrate that Performance-Based Logistics Contracts are Achieving Expected Benefits* (GAO-05-966, September 2005).

Parallel to the literature on "auctions versus negotiations" is the literature on pricing terms, often characterized as "fixed price versus cost plus." In the context of timber auctions, Leffler and Rucker (1991) found that simpler-to-specify tracts are more likely to be sold at fixed prices. Kalnins and Mayer (2004) found that when quality is difficult to measure, so difficult to contract on, the IT services industry uses more cost-plus contracts. Corts and Singh (2004) found that oil exploration companies increase their use of cost-plus contract for drilling contractors as their experience with those contractors grows, and posited that this change occurs because opportunities for repeat business strengthen the incentives for efficiency more than they reduce the costs of specifying complete contracts. Crocker and Reynolds (1993) found the opposite pattern, in the context of Air Force engine procurement, and argued that as the buyer gains more information over time, it becomes easier to write complete contingent contracts. Warren (2012) demonstrated that for civilian agencies, contracting officers with higher workloads—and therefore higher opportunity costs of specifying any given contract—use fewer fixed-price contracts. We found the opposite results in defense agencies: contracting officers in the DoD with higher workloads increase their usage of fixed-price contracts.

Finally, a very few studies have directly targeted the question of the costs and incidence of renegotiation and contractual incompleteness, independent of the contractual terms outlined above. Guasch, Laffont, and Straub (2008) found that concession contracts in Latin America are more likely to be renegotiated if the firm is not regulated or if the quality of the bureaucracy that oversees the concession is low. Bajari, Houghton, and Tadelis (2010) used a structural approach to analyze a set of California highway procurement auctions, and found that ex-post adaptation costs make up between 7–13% of the winning bid. Warren (2012) showed that increasing workload in civilian contracting agencies leads to more renegotiation and higher prices. Consistent with these results, we found that increasing workload in defense agencies increases the probability and frequency of contract modification as well as the prices paid by the defense agency; these effects are even greater for domestic contracts than for contingency contracts.

Many papers have looked at issues related specifically to procurement for defense agencies, including a high level of uncertainty, large economies of scale, and the potential for problems in the monopsony market for weapons systems. Rogerson (1995) and Hartley (2007) provide excellent overviews of the literature relating to defense procurement. However, the academic literature has paid very little attention to defense procurement in conflict areas. We rectified this omission by investigating the impact of changing workloads on procurement outcomes in Iraq and Afghanistan. We found that, relative to domestic defense contracts, workload has a greater impact on the usage of competitive acquisitions, but a smaller impact on other procurement terms, including award type, pricing terms, risk of renegotiation, and financial obligations. These results suggest that increasing the acquisitions workforce may not have as large an impact on contingency contracts.

In summary, this paper contributes to contract literature and expands our understanding of contingency contracting. Using extensive data on contracts and employment from the DoD, and taking advantage of workload, a new technique for identifying contractual incompleteness only recently introduced by Warren (2012), our results regarding the effect of incomplete contracts on contractual terms are generally consistent with the broader literature.

The DoD Procurement Process

The DoD's basic procurement process progresses in three stages. The process begins with the recognition of an agency need and the development of a procurement strategy intended to meet the need. It continues with the solicitation and award stage, and

ends with the contract management and closeout stage (Federal Acquisition Institute, 2003, pp. 27–30). In highly uncertain environments, the DoD uses a modified version of this basic procurement process. We characterize the basic three-stage procurement process in this section and describe two common modifications of this process in our Complex Contracting Environments section.

In the first stage, the agency determines that it has a need for a product (or service) that it cannot or does not wish to produce with "in-house" resources. A contracting officer employed with the agency then determines the optimal strategy for successfully procuring the desired product within the constraints of authorizing legislation, current market conditions, and the requirements of both the Federal Acquisition Regulation (FAR) and the Defense Federal Acquisition Regulation Supplement (DFARS). The agency must decide whether and how to compete the contract, the preferred pricing terms, and whether the contract will be for a definitive quantity or some indefinite-delivery vehicle.

After the agency determines the method of procurement and contractual form, it solicits bids from potential suppliers. The agency uses various means to request bids from potential contractors, including the Federal Business Opportunities website. The request for bids includes a description of the product or service the agency wishes to purchase, the contractors that are allowed to submit an offer, the form that these offers should take, and how the agency intends to evaluate the offers. As dictated by the agency's solicitation, contractors may respond with a simple price bid, a more complicated proposal, or even engage in bilateral or multilateral negotiations with the agency that include exchanges of proposals. The agency evaluates these proposals according to the provisions in the solicitation and an award is made.

Once the contract is awarded, production begins, and the agency begins the contract management stage. The agency oversees production, inspecting for quality, adherence to specifications, and auditing costs when appropriate. If unforeseen contingencies arise during production, the agency may choose to modify the original contract. These modifications may take the form of simple unilateral changes to the specifications or, in the case of significant changes, may require bilateral negotiations to determine an equitable adjustment of pricing. Finally, the contract is ended, either because the contract terms were fulfilled or because the agency terminated the contract for one of many possible reasons, including convenience or contractor default.

Complex Contracting Environments

When the procurement environment is particularly complex, the DoD uses a modified form of the procurement process described in the previous section. There are two main forms this advanced process can take: multi-stage procurements and umbrella contracts.

For complex items with large economies of scale, such as weapons systems, the DoD typically uses multi-stage procurements that repeat the basic procurement process described above in each stage. The following discussion of multiple-stage contracts is adapted largely from Rogerson (1995) who describes three procurement phases in a product life cycle. The first stage is a design stage, in which the agency awards cost-plus contracts to several firms who research and develop competing designs. The design stage has the most competition of the three stages, because, even though uncertainty about the final product is high, economies of scale are relatively low and the competition in research and development enables the agency to identify the best design. At the end of the design phase, the agency selects the two best designs to continue to the sole-source selection phase.

In the sole-source selection stage, the remaining two firms build prototypes, present final design plans, and submit bids for the initial production. Because relatively small quantities of most weapons systems are ever purchased, it is usually unprofitable for more than one firm to produce a particular weapon system. Therefore, at the conclusion of this stage, this agency will generally award production rights to only one firm.

The final phase of weapons procurement is the production stage. Even at this stage, large uncertainties persist because of the probable changes in both technology and the DoD's demand for the product, making long-term fixed-price production contracts impractical. Instead, the DoD typically relies on repeated fixed-price contracts that are signed for one year of production at a time. Because of the large economies of scale, these contracts are almost always negotiated in a sole-source environment, preventing competitive determination of prices. As a result, the government typically bases prices for these production contracts on historical and projected costs with the inclusion of a "profit" term. Moreover, the Truth in Negotiations Act (TINA) requires contractors to submit "current accurate and complete" cost estimates during negotiations of the contracted price. The combination of cost-based pricing and TINA means that small cost savings will only benefit contractors for one year before the cost savings are priced into the next contract, and unprecedentedly large cost savings may open contractors up to prosecution for hiding information and require them to refund these savings back to the DoD. In this environment, fixed-price contracts may not have any advantage over cost-plus contracts: the contractor has little incentive to provide cost-saving effort, and high uncertainty makes renegotiation likely.

The second major modified procurement form is the use of umbrella contracts. When an agency knows it will need a large quantity of some relatively standardized service or product, but the quantity is unknown, the agency may choose to write an indefinite-delivery vehicle (IDV), which specifies basic information about the desired good or service. The IDV then acts as a framework for future contracts. When the agency determines it needs the product or service, it makes a "call" on the corresponding IDV, filling in the incremental details, such as time, place, and manner of delivery. Agencies can make repeated calls on the same IDV. The advantage of an IDV is the ability to shortcut several stages in the procurement process; contracting officers do not have to re-specify and award the contract repeatedly for the same service. However, the IDV may not be well specified for every circumstance that generates a call on it, potentially creating the need for costly modifications. One prominent example of an IDV is the Logistics Civil Augmentation Program (LOGCAP), which provides broad logistics support to the U.S. Army including delivery of food supplies, postal services, and facilities maintenance. The most recent iteration, LOGCAP IV, was awarded in 2007 to three firms with a maximum value to each company of $5 billion annually for up to 10 years.

Contracting Officers

The primary DoD agents responsible for overseeing this procurement process are civil service employees in the occupational series GS-1102, generally referred to as contracting officers. The Position Classification Standard for the Contracting Series describes their role as follows:

> This series includes positions that manage, supervise, perform, or develop policies and procedures for professional work involving the procurement of supplies, services, construction, or research and development using formal advertising or negotiation procedures; the evaluation of contract price proposals; and the administration or termination and close out of contracts. The work requires knowledge of the legislation, regulations, and methods

used in contracting; and knowledge of business and industry practices, sources of supply, cost factors, and requirements characteristics.

There are a number of military and civilian support personnel that aid these contracting officers in the procurement process, including purchasing officers (GS-1105s, who concentrate on simplified acquisitions), procurement clerical and assistance series (GS-1106s, who provide clerical support), and contracting officer representatives and contracting officer technical representatives (various series, who develop the contract's technical requirements and determine if a contractor meets them). We only use ceteris paribus variation in the number of the civilian (GS-1102) contracting officers to measure changes in workload.

In the next section, we describe a model of the procurement process (details in Warren [2012]) that trace the effects of workload shock on procurement and contracting outcomes.

A Model of Procurement

This paper's predictions about the effect of workload on contractual completeness and procurement terms are derived from the model presented in Warren (2012) that extends the analysis in Bajari and Tadelis (2001) of the choice between fixed-price and cost-plus contracts to also include the choice between competition and negotiation. We present Warren's basic results in this section and invite the interested reader to follow up on the details in the original.

In Warren's model of the procurement process, the primary agent is a contracting officer who maximizes a utility function that depends on three elements: the value of the product or service, net of payments to the contractor; the cost of specifying contractual contingencies; and the cost of running a procurement competition.[6] The contracting officer chooses three variable characteristics of the contract: the level of contractual completeness, the pricing terms of the contract (i.e., fixed price or cost plus), and whether to run an open competition or to engage in negotiations with a single firm.

The value the contracting officer places on the product to be procured is exogenous and not affected by contracting terms. The final payment is dependent on the initial obligation, pricing terms, and the probability of renegotiation. The contracting officer has a choice of specifying a level of contractual completeness to cover potential contingencies: higher levels of contractual completeness reduce the probability that the contracting officer will have to engage in post-award renegotiations for off-contract performance. The contracting officer bears an exogenously given level of workload on other projects. When his workload increases, his opportunity cost of more fully specifying the current contract also increases.

In the event that a contract requires modification after production has started, the contracting officer faces two potential increases in cost. First, modifications should increase production costs on average since some costs are likely to be non-recoverable. Second, if the contracting officer chooses to award a fixed-price contract, then he must specify a modified contract and negotiate a new payment for this modified contract. We assume that the contracting officer must bear a friction cost associated with this re-specification and renegotiation of a fixed-price contract.[7]

[6] The contracting officer need not value the product or its price at the same rate as his political principle for the comparative statics to hold. All that is required is that he would prefer paying less to paying more, all else equal.
[7] In contrast, these frictions of renegotiation are completely avoidable with cost-plus contracts.

The primary purpose of this model is to predict the impact of an exogenous shift in the cost of contractual completeness induced by a change in the contracting officer's workload. An increase in a contracting officer's workload increases the marginal cost of completeness, necessarily reducing the equilibrium level of contractual completeness. This reduction of the optimal completeness will have important effects on the contracting officer's other equilibrium choices as well as on his final financial outlay.

Consider, first, the contracting officer's choice between fixed-price and cost-plus contracts. The advantage of a fixed-price contract is the incentive it creates for contractors to efficiently provide non-contractible cost-reducing effort, since the contractor is the residual claimant on any cost savings. In contrast, cost-plus contracts do not produce incentives for cost-saving effort, since any reduction in costs will result in an equal reduction in payment to the contractor. Since the contractor and contracting officer anticipate this cost-saving effort, the initial obligation under a fixed-price contract will be lower than with a cost-plus contract. The advantage of cost-plus contracts is the ease of renegotiation when unspecified contingencies arise. Rather than negotiating a new price for a modified contract, the contracting officer only needs to compensate the contractor for additional costs according to the terms of the original contract. If a contract were fully specified so that there would be no possibility of modification, the contracting officer would always prefer a fixed-price contract. However, as increasing workload induces the contracting officer to specify less and less of the contract, the ease of renegotiation from cost-plus contracts becomes more attractive. At some threshold of incompleteness, cost-plus contracts may become optimal.

Compare, next, the contracting officer's choice between open competition and single-source negotiation. The advantage of competition is the ability to select an ex-ante more efficient contractor. However, the advantage of competition disappears when modification is certain, since the ex-ante more efficient contractor may not have the lowest costs on the modified contract. The advantage of negotiation is the convenience to forgo the time and expense of conducting an open competitive procurement. As contracts become less and less complete, the benefits of competition diminish without any decline in the cost of running a competition (if anything, the time cost has increased). Hence, a higher workload that reduces completeness will make single-source negotiations more appealing.

Combining these results, we see that an exogenous increase in workload will induce the contracting officer to choose to write a less complete contract and increase his use of cost-plus contracts and single-source negotiations. These choices have important ramifications for both the initial contracted obligation and the final outlays. The initial price is affected by both the pricing terms and the extent of contract completeness. As completeness falls, the increased use of cost-plus contracts will result in fewer cost-saving efforts, and the increased use of negotiation will reduce the probability that the contracting officer will select the ex-ante most efficient contractor. Both of these effects will tend to increase the initial contracted price.

The final outlay depends on the initial price and the probability of renegotiation. In the absence of any modification, the final outlay approximately equals the initial price, but reduced contractual completeness increases the probability that the contract will need to be modified. Since some costs are non-recoverable, a modification generates higher total costs on average, again leading to higher final outlays. Finally, the higher probability of modification means that even when the contracting officer still prefers to use a fixed-price contract, he has a higher probability of having to bear the cost of renegotiation frictions, increasing the expected final outlays. In summary, an exogenous increase in workload, which decreases the equilibrium level of completeness, increases the expected final outlays due to a higher initial price, reduced cost-saving efforts from increased used of cost-plus

contracts, and increased probability of renegotiation, which increases both expected production costs and expected contracting costs.

In the empirical analysis below, we investigate and find evidence for the predicted effects of increased workload on the use of competition, the probability of renegotiation, initial obligations, and final outlays. The results on pricing terms conflict with the model.

Data and Methodology

We used a large public database of government contracts to build measures of workload and contractual/procurement terms. The contract data consisted of every non-classified transaction from FY2005–FY2010 above a reporting threshold of $3,000[8] for 32 DoD contracting offices, about 6.9 million actions in all.[9] Gathered from the Federal Procurement Data System (FPDS-NG), through usaspending.gov, the contract data included procurement contract transactions reported directly through the contract writing systems of the constituent agencies. Each initial government obligation appeared exactly once (4.6 million), as did every modification of a reported contract (2.3 million). For each contract, the FPDS-NG reports a broad range of information about the contracting parties, the contractual terms, the method of procurement, and the place of performance. The particular provisions that form the basis for the analysis are discussed in detail in this section.

We measured the number of contracting officers in an agency by counting the number of GS-1102s. The data on the GS-1102 employment in each contracting agency in each fiscal year came from the Office of Personnel Management's Central Personnel Data File. It reports the number of civilian contracting officers in each agency at the end of each fiscal year by years of experience in that agency.

Unfortunately, analysis of contracting in defense agencies has several complications that are not present for a similar analysis of civilian agencies (Warren, 2012). First, compared to civilian agencies, a larger share of defense contracts are classified for reasons of national security and are, thus, unreported. This missing-data issue had two implications for our analysis. First, we could only estimate effects for non-classified contracts and could say nothing concrete about whether these effects would also hold for classified contracts. Second, when estimating workload, we could only imperfectly control for the work on classified contracts. Contract counts for these classified contracts are not available, nor is budgetary information at the agency level. Instead, we controlled for the fraction of the branch procurement budget that is classified (from the OMB analysis of the DoD budget), where Army, Navy, and Air Force agencies are assigned the fraction for their branch and non-branch agencies are assigned the fraction classified of the non-branch DoD budget.

Second, procurement work in some defense agencies is shared with career military officers, but the Central Personnel Data File includes only civilian contracting officers. The only publicly available data we could find on this question is available at the branch level at a single point of time. Since our regression includes agency fixed effects, a control like that would be dropped.[10]

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[8] Original contracts below the $3,000 reporting threshold are known as "micropurchases," and are exempted from a number of competition and reporting requirements. We dropped all reported original contracts below this threshold, because reporting rates of micropurchases may adjust with workload.

[9] This consists of every DoD agency/sub-agency that reports non-zero GS-1102s to the OPM and more than 300 original definitive contractual actions to the FPDS-NG, with a few exceptions. See Table 10 for the list of agencies included in our sample.

[10] The appropriate data are available from the Defense Manpower Data Center, we believe, but they are not publicly available, and we have not been able to gain access to them.

Finally, the contracts data from the FPDS-NG and the employment data from the Central Personnel Data File are reported at different levels within the DoD's hierarchy. At the highest level, the DoD is divided into branches (e.g., Navy). These branches are subdivided into agencies (e.g., Naval Air Systems Command). Each of these agencies can be further subdivided into individual contracting offices. The FPDS-NG reports both the branch and the six-digit DoD Activity Address Code (DoDAAC) of the contracting office that issues each contract, but not the agency to which the contracting office belongs. The Central Personnel Data File reports employment of contracting officers only at the levels of the branch and the agency. To match the contracts to the appropriate employment information, we used the Defense Automatic Addressing System Inquiry System (DAASINQ)[11] to identify the agency to which each contracting office belongs. For example, the FPDS-NG reports contracts from a contracting office with DoDAAC N65886 in the Navy. According to DAASINQ, N65886 is the DoDAAC of the Fleet Readiness Center Southeast, which belongs to the agency Naval Air Systems Command (NAVAIR). Consequently, we assigned all contracts with DoDAAC N65886 to NAVAIR. We repeated this process for all contracts in the Navy, Army, and Air Force.[12]

In the Appendix, Table 10 lists additional details about these corresponding agencies, including their distribution of contracts, number of contracts in Iraq or Afghanistan, and number of contracting officers.

Contractual Types and Terms

Contractual characteristics vary immensely, even within a single agency. These contract characteristics can be divided into two main subsets: features over which contracting officers have little discretion and features over which contracting officers have more discretion. For example, contracting officers have little discretion over contract features such as product class, as these features are primarily determined by the nature of the good or service the agency wishes to acquire. Consequently, we primarily take these non-discretionary characteristics (described in more detail in this section) as exogenously given, and ignore the possibility that the agency will adjust these features on the margin when workloads change. There is one aspect of the contract, award type, over which the contracting officer may have limited discretion at the margin. For most of the analysis, we treat award type as given, and return at the end to the question of substitution among award types. Finally, contracting officers have a great deal of discretion over other contracting features such as the nature of competition and pricing terms. When contracting officers' workloads change, we looked for adjustments in the mix of these "discretionary" features. Specifically, we analyzed the effects of workload on four aspects of contracts: competition, pricing terms, modification, and outlays.

Contracts differ first according to the product or service the agency is procuring. The General Services Administration classifies every product or service purchased by the U.S. federal government as one of 24 broad services classes or one of 90 broad product classes.[13]

The FPDS-NG reports the primary product/service class of every contract. Some of these classes, such as Nuclear Ordinance, are not represented or are very small, so we

[11] Found online at https://www.daas.dla.mil/daasinq/
[12] FPDS-NG reports the agency instead of the branch for contracts issued by all independent DoD agencies (e.g., the Defense Contract Management Agency).
[13] For definitions see http://www.acquisition.gov/service product codes.pdf

merge them with neighboring categories. After these combinations, there are 55 broad product/service categories.[14]

Second, contracts differ according to the award type. Awards are first categorized by whether the contract specifies a fixed quantity (definitive contract) or not (indefinite delivery vehicle). Awards can also be categorized by whether they are original (i.e., new) contractual actions or modifications to existing contracts. For this paper, the unit of observation is the original contract. We do not consider the effect of workload on the contractual terms of modifications, because the terms of a modified contract depend in part on the terms specified in the original contract. Consequently, it is unclear whether the workload at the time of the original contract or the workload at the time of the modification should affect the terms of the modified contract. Moreover, the existence of the modification is, itself, an outcome that might be affected by workload, so sample selection is a concern when looking at the contractual terms of modifications. Within the class of definitive contracts, a given acquisition occurs either under simplified acquisitions procedures (for procurements below $150,000) or under general acquisitions procedures. Simplified definitive contracts are referred to as purchase orders and make up the majority of the definitive contracts (about 1.3 million out of 1.4 million), but the minority of definitive procurement dollars (about $40 billion out of $420 billion in the sample).

In addition to the two sorts of definitive contracts, there is a third award type, referred to here as "delivery orders," which consists of calls on IDVs. As discussed above, an IDV is an umbrella contract that specifies a framework under which a broad class of specific procurements can be made. A delivery order is a specific agreement to procure under the broad terms of the IDV, but under the further specific terms and conditions particular to that specific procurement. A delivery order is a contract in its own right, with its own terms and modifications, but the contracting officer does not start from scratch, so his flexibility is somewhat limited. These sorts of contracts are very important, making up over 3 million of the 4.6 million original contracts, and more than half of all procurement spending (about $800 billion out of the $1.45 trillion in procurement spending by the DoD in our sample years).

There are four main features of contracts that contracting officers can adjust as their workloads vary. The first discretionary feature is the pricing structure. For simplicity, we divided the pricing structure of contracts into two broad categories: firm-fixed-price contracts and variable-price contracts. In fact, contracting officers can choose from a continuum of pricing structures, including firm fixed price; fixed price with various price adjustments, effort requirements, and incentive payments; cost plus fixed fee; cost plus various incentive fees; time and materials; and other various hybrid forms. Firm-fixed-price contracts make up 88% of all original contracts in our sample. The FAR specifies that agencies should use fixed-price contracts when "the risk involved is minimal or can be predicted with an acceptable degree of certainty." Official government policy is to prefer firm-fixed-price contracts when possible (especially recently, with an order from the Office of Federal Procurement Policy).

The second discretionary feature available to contracting officers is the extent to which the contract is competed. The most competitive option, called "full-and-open competition," allows all responsible sources to compete. Full-and-open competition includes sealed bids, competitive proposals, and combinations of competitive procedures. Contracting officers can also choose a more limited form of competition, called "full-and-open competition after exclusion of sources," which prohibits some otherwise qualified sources from participating in the competition. Sources may be excluded if doing so would

[14] Details of matches are available by request.

reduce total costs without harming competition, aid national defense, maintain a reliable source, or fulfill a critical need. Officers are not required to report the reason for exclusion, but it is an optional data element. Among those who report (27%), the most commonly cited reasons are that a contract is a follow-on contract or has some unique sources. Finally, a contracting officer may choose not to compete a contract at all, either because a statue explicitly prohibits competition (not available for competition) or because only one source was solicited for reasons authorized by regulation and justified by the contracting officer (not competed). The most common justifications for not competing a contract are the availability of only one responsible source who can satisfy agency requirements and unusual and compelling urgency.

Third, the extent to which a contracting officer completely specifies an original contract influences the probability of modification and the number of modifications of the original contract. There are several reported reasons for contract modifications. Over half of the reported modifications are strictly administrative, a funding-only action, or a closeout of a completed contract. But about 41% of modifications reflect a substantial change in the contract's requirements: unilateral requests for additional work, change orders, the exercise of options, and bilateral supplemental agreements. The remaining 3% are an assortment of cancelations, terminations, and movements between definitive and indefinite contracts.

Finally, the choices the contracting officer makes with respect to competition, pricing terms, and modifications influence the size of the government's financial obligation from a contract. Every original contract has an initial level of expected obligation determined at the time of the contract award, which may be altered by later modifications. We looked at initial and final obligation separately, since the model predicts individual effects on each.

Tables 1–3 present the summary statistics for the contract and agency features that form the basis for our regressions. Table 1 presents the statistics for definitive contracts. The two major columns divide these contracts into firm-fixed-price and variable-price contracts, while the sub-columns further divide them into contracts that are eventually modified and those which are not. Each row is the sample mean and standard deviation from the indicated variable in the appropriate subset of contracts. The top panel includes contract-level variables, while the bottom panel includes agency-level variables, averaged over all the contracts of the indicated type. Tables 2 and 3 are similarly structured, but for purchase orders and delivery orders, respectively.

Table 1. Original Definitive Contracts

	Variable Price		Firm-Fixed Price	
	No Mod.	Mod.	No Mod.	Mod.
Pct. Mod.	63		40	
Full-and-Open Comp.	0.281	0.396	0.416	0.392
	(0.450)	(0.489)	(0.493)	(0.488)
Excl. of Sources	0.410	0.434	0.278	0.231
	(0.492)	(0.496)	(0.448)	(0.421)
Not Comp.	0.0571	0.117	0.204	0.168
	(0.232)	(0.322)	(0.403)	(0.374)
Init Oblig ($M2009)	0.809	2.808	0.365	2.439
	(8.471)	(40.61)	(2.680)	(34.82)
Final Oblig ($M2009)	1.066	14.90	0.390	4.883
	(8.724)	(188.9)	(3.076)	(51.60)
Modifications	0	4.806	0	3.438
	(0)	(29.47)	(0)	(6.393)
Pct. Classified	0.138	0.127	0.0961	0.0837
	(0.190)	(0.184)	(0.143)	(0.159)
Pct. 10–20	0.202	0.204	0.177	0.192
	(0.0650)	(0.0554)	(0.0530)	(0.0586)
Pct. 20+	0.514	0.531	0.529	0.537
	(0.0865)	(0.0694)	(0.101)	(0.0937)
C. Officers	1105.2	1051.0	1346.9	940.6
	(977.0)	(913.6)	(1024.8)	(745.1)
n	6794	11306	57394	37665

Notes. Sample means and standard deviations for definitive contracts by pricing variety and eventual modification. The full sample includes contracts from 32 agencies over up to six years (2005–2010), although the Army agencies are limited to 2005–2008. Top panel variables are contract-level data elements and bottom panel variables are office-level data elements, weighted by the number of contracts.

Table 2. Purchase Orders

	Variable Price		Firm-Fixed Price	
	No Mod.	Mod.	No Mod.	Mod.
Pct. Mod.	21		11	
Full-and-Open Comp.	0.335	0.204	0.558	0.358
	(0.472)	(0.403)	(0.497)	(0.479)
Excl. of Sources	0.111	0.208	0.219	0.258
	(0.314)	(0.406)	(0.414)	(0.437)
Not Comp.	0.438	0.458	0.197	0.330
	(0.496)	(0.498)	(0.398)	(0.470)
Init Oblig ($M2009)	0.125	0.0902	0.0248	0.0592
	(2.948)	(0.299)	(0.160)	(0.228)
Final Oblig ($M2009)	0.127	0.137	0.0252	0.0829
	(2.949)	(0.437)	(0.164)	(1.440)
Modifications	0	1.819	0	1.430
	(0)	(1.392)	(0)	(1.023)
Pct. Classified	0.0941	0.0623	0.0946	0.0598
	(0.103)	(0.139)	(0.107)	(0.135)
Pct. 10–20	0.190	0.211	0.172	0.196
	(0.0433)	(0.0530)	(0.0558)	(0.0671)
Pct. 20+	0.477	0.515	0.494	0.511
	(0.0766)	(0.0725)	(0.0829)	(0.101)
C. Officers	819.6	1077.9	1748.8	891.7
	(810.8)	(679.3)	(1059.8)	(794.5)
n	5200	1414	1.2M	143k

Notes. Sample means and standard deviations for purchase orders by pricing variety and eventual modification. The full sample includes contracts from 32 agencies over up to six years (2005–2010), although the Army agencies are limited to 2005–2008. Top panel variables are contract-level data elements and bottom panel variables are office-level data elements, weighted by the number of contracts.

Table 3. Delivery Orders

	Variable Price		Firm-Fixed Price	
	No Mod.	Mod.	No Mod.	Mod.
Pct. Mod	15		9	
Full-and-Open Comp.	0.695	0.625	0.702	0.594
	(0.461)	(0.484)	(0.458)	(0.491)
Excl. of Sources	0.162	0.145	0.161	0.227
	(0.369)	(0.352)	(0.368)	(0.419)
Not Comp.	0.114	0.138	0.0955	0.110
	(0.318)	(0.345)	(0.294)	(0.313)
Init Oblig ($M2009)	0.203	1.277	0.0920	0.728
	(6.431)	(16.05)	(1.169)	(8.833)
Final Oblig ($M2009)	0.225	3.168	0.0939	1.004
	(6.508)	(50.02)	(1.201)	(12.79)
Modifications	0	2.446	0	1.846
	(0)	(3.813)	(0)	(2.385)
Pct. Classified	0.112	0.0815	0.108	0.0775
	(0.110)	(0.159)	(0.0810)	(0.144)
Pct. 10–20	0.184	0.202	0.163	0.195
	(0.0593)	(0.0572)	(0.0476)	(0.0584)
Pct. 20+	0.499	0.544	0.482	0.509
	(0.0719)	(0.0824)	(0.0621)	(0.0892)
C. Officers	1811.2	808.5	2090.4	1046.8
	(1027.6)	(773.5)	(901.1)	(829.9)
n	422k	77k	2.3M	241k

Notes. Sample means and standard deviations for delivery orders by pricing variety and eventual modification. The full sample includes contracts from 32 agencies over up to six years (2005–2010), although the Army agencies are limited to 2005–2008. Top panel variables are contract-level data elements and bottom panel variables are office-level data elements, weighted by the number of contracts.

For definitive contracts, 63% of the variable-price definitive contracts are eventually modified, while only 40% of the fixed-price definitive contracts are. This same pattern holds for the other two award types. We also see that, conditional on being modified, variable-price contracts are modified more frequently. Finally, there appears to be bigger changes to the variable-price contracts, at least in terms of the change in dollars obligated between the initial and final levels. This pattern is consistent with the idea that contracting officers choose variable-price contracts if renegotiation is likely.

The sample statistics reveal no obvious pattern of competition. For definitive contracts, the firm-fixed-price contracts appear to be more subject to full-and-open competition and less subject to exclusion of sources, but they are also more likely to be not competed at all. Purchase orders are similar, but for delivery orders there does not seem to be much difference in the use of competition among pricing terms.

Now consider workload. Firm-fixed-price contracts are, on average, being written by agencies with more contracting officers, across all three award types. For definitive contracts, the average firm-fixed-price contract is written in an agency with 1,184 contracting

officers, while the average variable-price contract is written in an agency with 1,072 officers. The difference is even bigger for the other two award types. A similar pattern arises when comparing modified contracts to non-modified contracts within an award type and pricing class. For every award/pricing combination, except for variable-price purchase orders (of which there are only 6,600), the average non-modified contract was written in an agency with many more contracting officers than the average modified contract. Again, this pattern is consistent with the idea that agencies with many people to do the work write more complete contracts and make greater use of fixed-price contracts.

Finally, consider the distribution of contractual terms when we consider only those contracts performed in Iraq and Afghanistan. Table 4 presents those data for all award types pooled together. Essentially, there are two sets of contracts in Iraq and Afghanistan. There are a handful (about 600) of enormous variable-price delivery orders written off the LOGCAP IV and related IDV umbrella contracts. These make up about 70% of the non-classified procurement spending in our sample of contracts in Iraq and Afghanistan. But even within this class there is some variation. For example, about a quarter of these delivery orders are executed as written, and it is still true that these unmodified contracts were written by agencies with more contracting officers on staff. The rest of the procurement in Iraq and Afghanistan is made up of a large collection of relatively small firm-fixed-price contracts (about 45,000). They are overwhelmingly subjected to full-and-open competition, rarely modified, and mostly consist of purchase orders and relatively small definitive contracts.

Table 4. Contracts Performed in Iraq or Afghanistan

	Variable Price		Firm-Fixed Price	
	No Mod.	Mod.	No Mod.	Mod.
Definitive	0	0.0409	0.163	0.290
	(0)	(0.198)	(0.369)	(0.454)
Purch Order	0.00641	0.00430	0.656	0.525
	(0.0801)	(0.0655)	(0.475)	(0.499)
Delivery	0.994	0.955	0.181	0.185
	(0.0801)	(0.208)	(0.385)	(0.388)
Full and Open Comp.	0.801	0.845	0.992	0.971
	(0.400)	(0.362)	(0.0914)	(0.167)
Excl. of Sources	0.128	0.0774	0.000960	0.00497
	(0.335)	(0.268)	(0.0310)	(0.0703)
Not Comp.	0.0256	0.0624	0.00693	0.0186
	(0.159)	(0.242)	(0.0830)	(0.135)
Init Oblig ($M2009)	6.156	19.62	0.211	1.433
	(16.30)	(72.64)	(2.754)	(6.182)
Final Oblig ($M2009)	8.524	86.14	0.210	1.928
	(33.29)	(573.6)	(3.080)	(11.12)
Modifications	0	5.065	0	2.064
	(0)	(7.449)	(0)	(6.007)
Pct. Classified	0.222	0.273	0.000919	0.00642
	(0.200)	(0.200)	(0.0150)	(0.0454)
Pct. 10–20	0.181	0.188	0.171	0.178
	(0.0460)	(0.0458)	(0.0110)	(0.0235)
Pct. 20+	0.524	0.546	0.653	0.609
	(0.0716)	(0.0543)	(0.0805)	(0.0721)
C. Officers	1645.7	1556.7	283.7	413.6
	(1065.7)	(987.8)	(183.3)	(399.3)
n	156	465	42k	4631

Notes. Sample means and standard deviations for contracts performed in Iraq and Afghanistan by pricing variety and eventual modification. The full sample includes contracts from 32 agencies over up to six years (2005–2010), although the Army agencies are limited to 2005–2008. Top panel variables are contract-level data elements and bottom panel variables are office-level data elements, weighted by the number of contracts.

Although the patterns in the sample statistics are broadly consistent with our explanation for the role of contracting officer workload, differences in sample means could very easily be driven by lots of factors that just happen to be correlated with the number of contracting officers. In the next section, we will control for many of these factors econometrically in order to uncover the direct relationship between workload and contractual terms.

Econometric Specification of Workload

Designing a measure of workload that is consistent across agencies and time is challenging for several reasons. For example, the problems of using straightforward workload measures, such as the number of contracts per officer or the dollars obligated per

officer, have been well established (Black, 1995; Reed, 2010; Warren, 2012) and are present here as well. The degree of contract complexity varies across agencies, so simply adding up the number of contracts or dollars would overstate the workload of officers in those agencies who have relatively simple tasks to perform and understate the workload of officers in those agencies with relatively complex tasks. Since contracting officers' choices of the procurement and contractual terms are impacted by the product or service's complexity, these simple measures of workload would produce biased results. As a result, we did not try to directly estimate the workload per officer. Instead, we focused on the impact of changes in the total number of contracting officers in an agency, while controlling for the number and mix of contracts the officers must manage.

Others have attempted to create consistent measures of workload by applying an ex-ante weighting scheme among contracts (Air Force Manpower & Innovation Agency [AFIMA], 2001; Reed, 2010). However these weighted measures of workload are infeasible for this study for a couple of reasons. First, some of these measures do not account for variance in cross-agency time use, and, therefore cannot be consistently applied in a cross-agency study. Second, workload measures that can be applied consistently across agencies use weights that depend on the very outcomes we want to examine: dollars obligated, extent competed, and solicitation procedures. Using a workload measure that depends on any of these equilibrium outcomes would produce biased results.

Given the problems with these ex-ante workload weights, we instead took a flexible approach, letting the data determine the work intensity of various contracting actions. To measure the workload, we included a variable for (the log of) the number of contracting officers in each agency/year combination. To control for the contract mix, we counted the (log of) the number of original contracts for each of 55 different product/services classes for each agency/year combination. These counts were then included in each regression as 55 separate controls, indexed by *j*.

Another concern with appropriately measuring workload is that many defense contracts are classified and are not reported for national security reasons. If the share of contracts varies across agencies, then our workload measures will understate the workload of agencies with many unreported contracts and overstate the workload of agencies with few or no classified contracts. To control for this, we included a proxy of the intensity of classification in the office—the fraction of the branch's procurement budget that is classified in the fiscal year. Unfortunately, this measure is only available at the branch level (Army, Navy, Air Force, and other DoD) and not at the individual office level.

Finally, every regression included measures of contracting-officer experience, including the fraction with 10–20 years of experience and the fraction with over 20 years of experience, agency fixed effects and trends, a year fixed effect, and product/service fixed effects. Formally, we estimated the following Fixed-Effects OLS (FE-OLS) equation for contract *i* in product class *p* in agency *s* in year *t*.

$$y_{ipst} = \beta_1 CO_{st} + \beta_2 CO_{st} * IA_{ipst} + \eta IA_{ipst} + \delta^0 E_{st} + \sum_{j=1}^{55} \alpha_j X_{jst} + \sigma C_{st} + \gamma_{pst} + \kappa_s year_t + \varepsilon_{ipst} \quad (1)$$

In Equation 1, employment (*CO*) and contract counts (*X*) are measured in logs; *IA* is a dummy variable equal to 1 for a contract performed in Iraq or Afghanistan; *E* is the vector of experience controls; C_{st} is the share of classified procurement, γ_{pst} is the combination of three fixed effects (agency, year, and product class); $\kappa_s year_t$ is an agency-specific year trend, and *y* is the outcome of interest. Across various contracting outcomes, our interest

was in estimating the βs, the effect of expanding the contracting workforce on that outcome. Intuitively, β reflects the change in contracting outcomes for an agency when its number of contracting officers deviates from trend, given contract load, mix, and experience, while controlling for agency, year, and product-specific factors. The errors among contracts in a given agency-year will likely be correlated, so we clustered our standard errors at the agency-year level for inference.

The econometric approach here is very similar to that in Warren (2012), but it differs in two ways. First, we were not able to avail ourselves of Warren's instrumental-variable strategy of using retirements as a shock to workload. Since the DoD procurement offices are much larger than those found in most civilian agencies, they have about three times as many GS-1102s, on average. By the law of large numbers, this increased size irons out much of the random variation in retirement rates. Unfortunately, this leads to a very weak and non-robust first-stage relationship between retirement rates and contracting-officer employment in the DoD agencies. Without an IV strategy, we are particularly concerned with omitted variable bias if agency mission changes over time (since that would not be captured in agency fixed effects). For this reason, we introduced a second difference from Warren—the introduction of agency-specific time trends. This more flexible specification will be robust to omitted factors that vary within an agency, over time, as long as they trend roughly with time. Finally, it is important to note that the biases Warren uncovered for the OLS regressions were all biases toward zero, so if the underlying omitted variables are similar, here, we can at least sign the bias of our estimated coefficients.

Results

Modifications

Table 5 outlines the estimated relationship between decreasing workload and the presence and number of substantive modifications or terminations. For this analysis, alone, we limited the sample to contracts written before 2009, since enough time must pass to observe any modifications. The first column presents estimates for the sample of definitive contracts, while the second and third present purchase orders and delivery orders, respectively. Our expectation was that busier contracting offices should write less complete contracts, leading to an increase in ex-post renegotiation that would be reflected in increased rates of modification and termination.

Table 5. The Effect of Workload on Renegotiation

	Def. Contract	Purch. Order	Del. Order
	Panel A: Termination		
C. Officers	−0.08**	−0.06***	−0.03*
	(0.04)	(0.01)	(0.02)
C. Officers x IorA	0.03*	−0.02	0.01
	(0.02)	(0.01)	(0.01)
Iraq or Af.	−0.11	0.12	−0.05
	(0.08)	(0.08)	(0.05)
Pct. 10–20	0.14*	0.24***	−0.11***
	(0.08)	(0.02)	(0.01)
Pct. 20+	−0.10*	−0.00	−0.09*
	(0.06)	(0.01)	(0.05)
	Panel B: Any Substantive Modifications		
C. Officers	−0.39***	0.37**	−0.64**
	(0.11)	(0.18)	(0.27)
C. Officers x IorA	0.09*	−0.23**	0.15***
	(0.05)	(0.09)	(0.06)
Iraq or Af.	−0.48	1.60***	−0.95**
	(0.35)	(0.64)	(0.39)
Pct. 10–20	−0.80***	1.31***	−1.13***
	(0.17)	(0.39)	(0.23)
Pct. 20+	0.39***	−0.42	−0.82
	(0.15)	(0.33)	(0.64)
	Panel C: Number of Substantive Modifications		
C. Officers	−2.16***	0.40***	−1.17**
	(0.21)	(0.14)	(0.53)
C. Officers x IorA	0.16*	−0.29***	0.14
	(0.09)	(0.10)	(0.11)
Iraq or Af.	−0.88	2.03***	−0.71
	(0.59)	(0.68)	(0.74)
Pct. 10–20	0.51	0.95***	−0.78***
	(0.65)	(0.32)	(0.31)
Pct. 20+	1.89***	−0.42	−1.86
	(0.25)	(0.27)	(1.30)
n	89k	0.97M	2.7M

Notes. Panel A Dependent Variable: Indicator of a contractual termination. Panel B Dependent Variable: Indicator of a subsequent substantive modification. Panel C Dependent Variable: the log of one plus the number of substantive modifications. Definitive contracts are included in specification (1), Purchase Orders in specification (2), and Delivery Orders in specification (3). In addition to the tabulated regressors, each specification includes the log of the number of original contracts in 55 product/service groups, product/service fixed effects, agency fixed effects and trends, and year fixed effects. The full sample includes contracts from 32 agencies over up to four years (2005–2008). Standard errors, in parenthesis, are clustered by agency-year. *, **, *** represent significance at the 0.10, 0.05, and 0.01 levels, respectively.

All three showed significant effects of workload on contract terminations, in the expected direction for non-Iraq/Afghanistan contracts. Increasing the number of contracting officers by about 10% when the original contract was signed decreased the probability that the contracted was later terminated by between 0.3–0.8 percentage points, on a mean of less than 1%. The relationship for contracts in Iraq and Afghanistan seemed a little weaker, but it is difficult to make much of these result, since less than 0.1% of such contracts are ever terminated.

The results for modifications were more mixed. For definitive contracts and delivery orders, more contracting officers were associated with fewer modifications, along both the extensive and intensive margins. In particular, increasing the number of contracting officers by 10%, decreased the probability of modification by about 3–6 percentage points, and decreased the expected number of modifications by 10–20%. These relationships may be slightly weaker for contracts in Iraq/Afghanistan, but they were substantively quite similar. Purchase orders, by contrast, seemed to be more modified as workload declined, at least for contracts not performed in Iraq and Afghanistan. In Iraq and Afghanistan, there seemed to be no relationship between workload and modification of purchase orders.

To judge the size of these effects, about 10% of delivery contracts and purchase orders in the sample were modified at some point, while about 40% of definitive contracts were. The average delivery or purchase order had about 0.18 modifications, while the average definitive contracts had about 1.8.

Consistent with the predictions of the model and the evidence for civilian agencies (Warren 2012), as workload declines, agencies seem to do a better job at foreseeing contingencies in the original contract and delivery orders, thereby limiting the need for ex-post renegotiation or termination. This relationship also holds up for the presumably simpler acquisitions tasks of purchase orders, in the case of terminations, but seems to reverse for modifications. We saw this pattern throughout much of our analysis, where the model did well in prediction behavior on relatively difficult contracts, but fell short in explaining behavior on the simple purchase orders.

Degree of Competition

Table 6 outlines the estimated relationship between workload and the decision to award a contract by competitive mechanisms. For definitive contracts and delivery orders, more contracting officers were associated with increased use of competitive procurement mechanisms. In particular, increasing the number of contracting officers by 10% increased the probability of full-and-open competition by between about 2–4 percentage points, decreased the use of competition with excluded sources by about 1 percentage point, and decreased the probability that a contract was not competed at all by between 1–2 percentage points. The effects may be slightly stronger for contracts performed in Iraq and Afghanistan, but the difference was not substantively very large. To give a sense of magnitudes, about 40% of definitive contracts and 69% of delivery orders were fully and openly competed, while about 28% and 17%, respectively, were competed after exclusion. Finally, about 10% of delivery orders and 18% of definitive contracts were not competed at all. Again, we found no consistent relationship between workload and competition for purchase orders.

Table 6. The Effect of Workload on Competition

	Def. Contract	Purch. Order	Del. Order
Panel A: Full-and-Open Competition			
C. Officers	0.37***	0.03	0.18***
	(0.13)	(0.12)	(0.04)
C. Officers x IorA	0.11**	−0.24	0.02
	(0.05)	(0.18)	(0.06)
Iraq or Af.	−0.37	2.03*	0.18
	(0.34)	(1.23)	(0.43)
Pct. 10–20	0.32	0.12	0.18*
	(0.40)	(0.38)	(0.10)
Pct. 20+	−0.01	−0.33	0.15*
	(0.35)	(0.27)	(0.08)
Panel B: Competition with Exclusion			
C. Officers	−0.13	−0.05	−0.09***
	(0.14)	(0.10)	(0.03)
C. Officers x IorA	−0.02	0.09	0.01
	(0.03)	(0.06)	(0.02)
Iraq or Af.	−0.04	−0.92**	−0.33***
	(0.21)	(0.42)	(0.13)
Pct. 10–20	−0.59	−0.23	−0.31***
	(0.40)	(0.36)	(0.08)
Pct. 20+	0.07	0.61**	−0.05
	(0.33)	(0.28)	(0.06)
Panel C: Not Competed			
C. Officers	−0.18**	0.12	−0.10**
	(0.08)	(0.08)	(0.04)
C. Officers x IorA	−0.06	0.07	−0.05
	(0.05)	(0.15)	(0.05)
Iraq or Af.	0.37	−0.54	0.36
	(0.35)	(0.99)	(0.37)
Pct. 10–20	−0.04	0.39**	0.16**
	(0.17)	(0.16)	(0.08)
Pct. 20+	0.03	−0.33**	−0.12*
	(0.17)	(0.16)	(0.07)
n	113k	1.36M	3.03M

Notes. Dependent variable: Indicator of use of given level competition. Not available for competition is the excluded class. Definitive contracts are included in specification (1), Purchase Orders in specification (2), and Delivery Orders in specification (3). In addition to the tabulated regressors, each specification includes the log of the number of original contracts in 55 product/service groups, product/service fixed effects, agency fixed effects and trends, and year fixed effects. The full sample includes contracts from 32 agencies over up to six years (2005–2010). Standard errors, in parenthesis, are clustered by agency-year. *, **, *** represent significance at the 0.10, 0.05, and 0.01 levels, respectively.

This shift toward competitive acquisitions procedures as the contracting workforce increases is exactly what the model predicts and is consistent with the results for civilian agencies (Warren, 2012).

Pricing Structure

Table 7 presents the estimated relationship between decreasing workload and the pricing structure chosen by the contracting officer. Agencies with more contracting officers than we would expect, given their mix of contracts, seemed to be less likely to use firm-fixed-price contracts, at least for definitive contracts and purchase orders performed outside of Iraq and Afghanistan and for delivery orders performed in Iraq or Afghanistan. Increasing the number of contracting officers by 10% was associated with a decrease in the use of firm-fixed-price contracts of between 2–3 percentage points. This was on a mean of about 83% for delivery orders and definitive contracts, and a mean of more than 99.5% for purchase orders. Note, however, that within Iraq and Afghanistan, these rates rose to nearly 100% for definitive contracts and purchase orders, and to 93% for delivery orders, so the coefficients for the Iraq/Afghanistan sample should be interpreted with care.

Table 7. The Effect of Workload on Contract Pricing

	Def. Contract	Purch. Order	Del. Order
	Use of Firm-Fixed-Price Contracts		
C. Officers	−0.19∗∗	−0.05∗	−0.16 (0.13)
	(0.09)	(0.03)	
C. Officers x IorA	0.04	0.02∗∗∗	−0.16∗∗
	(0.04)	(0.01)	(0.08)
Iraq or Af.	−0.29	−0.11∗∗∗	1.02∗∗
	(0.27)	(0.04)	(0.51)
Pct. 10–20	−0.02	−0.16∗∗	−0.33
	(0.14)	(0.07)	(0.33)
Pct. 20+	−0.05	0.03	−0.46
	(0.14)	(0.06)	(0.29)
n	113k	1.36M	3.03M

Notes. Dependent variable: Indicator of use of a firm-fixed-price contract. Definitive contracts are included in specification (1), Purchase Orders in specification (2), and Delivery Orders in specification (3). In addition to the tabulated regressors, each specification includes the log of the number of original contacts in 55 product/service groups, product/service fixed effects, agency fixed effects and trends, and year fixed effects. The full sample includes contracts from 32 agencies over up to six years (2005–2010). Standard errors, in parenthesis, are clustered by agency-year. *, **, *** represent significance at the 0.10, 0.05, and 0.01 levels, respectively.

Nevertheless, this result is quite at odds with the prediction of the model and the evidence in civilian agencies from Warren (2012). This divergence suggests that our framework may be ignoring some factor guiding the pricing decisions in the DoD that was not in play in the civilian agencies. As discussed in the Complex Contracting Environments section, many fixed-price contracts written by the DoD are highly cost based and, therefore, depress the cost-saving incentives generated by more typical fixed-price contracts. As fixed-price contracts become more like cost-plus contracts, the estimated effect of workload should fall toward zero as contracting officers become indifferent between fixed-price contracts and cost-plus contracts. However, this story cannot explain why the estimated effect shifted from positive to negative.

Obligations

Table 8 outlines the estimated relationship between workload and the initial and final amount obligated on the contract, taking into account later adjustments when applicable. For definitive contracts and purchase orders, outside Iraq and Afghanistan, the use of more contracting officers was associated with lower initial and final obligations, although the effect was bigger for initial than for final obligations. The relationship seemed to be weaker for contracts performed in Iraq and Afghanistan, but for definitive contracts, at least, it was still quite large. For definitive contracts, increasing the number of contracting officers by 10% would decrease initial obligations by 5–6.5% and decrease final obligations by about 5%. These results are consistent with the model and the results for civilian agencies (Warren, 2012).

Table 8. The Effect of Workload on Obligations

	Def. Contract	Purch. Order	Del. Order
	Panel A: Initial Dollars Obligated		
C. Officers	−0.65∗∗∗	−0.22∗∗	−0.12 (0.17)
	(0.24)	(0.10)	
C. Officers x IorA	0.17	0.06	0.41∗
	(0.17)	(0.38)	(0.24)
Iraq or Af.	0.24	0.20	−0.64
	(1.13)	(2.60)	(1.61)
Pct. 10–20	−1.42∗∗	0.41∗	−0.61
	(0.67)	(0.24)	(0.80)
Pct. 20+	0.11	0.31∗	−0.76
	(0.53)	(0.19)	(0.65)
	Panel B: Total Dollars Obligated		
C. Officers	−0.55∗∗	−0.14	0.06
	(0.26)	(0.10)	(0.18)
C. Officers x IorA	0.07	0.11	0.43
	(0.21)	(0.40)	(0.27)
Iraq or Af.	0.58	−0.15	−0.75
	(1.40)	(2.72)	(1.82)
Pct. 10–20	−1.03	0.42∗	0.16
	(0.74)	(0.24)	(0.81)
Pct. 20+	−0.09	0.35∗	−0.26
	(0.62)	(0.19)	(0.65)
n	113k	1.36M	3.03M

Notes. Dependent variables: The natural log of the initial and final (to date) obligations, measured in real 2009 dollars. Definitive contracts are included in specification (1), Purchase Orders in specification (2), and Delivery Orders in specification (3). In addition to the tabulated regressors, each specification includes the log of the number of original contacts in 55 product/service groups, product/service fixed effects, agency fixed effects and trends, and year fixed effects. The full sample includes contracts from 32 agencies over up to six years (2005–2010). Standard errors, in parenthesis, are clustered by agency-year. *, **, *** represent significance at the 0.10, 0.05, and 0.01 levels, respectively.

There was some evidence that the relationship could go the other way for delivery orders, at least in Iraq and Afghanistan, although the effect was not quite statistically significant at conventional levels. This interaction is particularly interesting because it suggests that increases in the size of the contracting workforce are unlikely to lead to much cost cutting on the large delivery orders that make up such a large part of the procurement in Iraq and Afghanistan.

Contract Types

To this point, we have analyzed the three major contract award types in parallel. For many procurement decisions, the contracting award type is more or less dictated by the object and context of the procurement. But there are always marginal cases, and it is important to understand the patterns of substitution among the award type for at least two reasons. First, one of the worries cited by the Commission on Wartime Contracting in Iraq and Afghanistan (2011) is that inadequate staffing of contracting offices operating in Iraq and Afghanistan has led them to depend inappropriately on the use of delivery orders, when one-off definitive contracts would have been more appropriate. We can investigate this question empirically.

Second, in the previous analysis, we sometimes found that the relationship between workload and contracting outcomes differed by award type. If there were big substitutions among award types, we might worry that these difference were simply due to sample selection. Take the example of modification. We found that higher workload was associated with more modification of delivery orders and definitive contracts, and lower modification of purchase orders. If we found that increased workload was also associated with substitution from purchase orders relative to those other two award types, we might worry that there is no real effect on modification and, instead, the contracting officers are simply changing the contracts they are likely to eventually modify from delivery orders or definitive contracts into purchase orders.

In fact, we found that all the substitution seems to occur between definitive contracts and delivery orders. Table 9 presents these estimates, where each column is a single regression with an indicator for the named award type as the dependent variable. For contracts not performed in Iraq or Afghanistan, we found that having more contracting officers is associated with an increased use of definitive contracts and a decreased use of delivery contracts. There was no statistically significant evidence of a change in the frequency of purchase orders. Increasing the number of contracting officers in an agency by about 10% would increase the use of definitive contracts by about 0.6 percentage points, decrease the use of delivery orders by about 1.2 percentage points, and increase the use of purchase orders by (a statistically insignificant) 0.6 percentage points. On average, only about 2.5% of original contracts were definitive contracts, 67% were delivery orders, and 30% were purchase orders.

Table 9. The Effect of Workload on Award Type

	Def. Contract	Purch. Order	Del. Order
C. Officers	0.06***	0.06	−0.12***
	(0.02)	(0.04)	(0.04)
C. Officers x IorA	−0.05***	0.02	0.03
	(0.02)	(0.04)	(0.04)
Iraq or Af.	0.37***	−0.20	−0.17
	(0.13)	(0.25)	(0.29)
Pct. 10–20	−0.02	0.37***	−0.35***
	(0.07)	(0.11)	(0.14)
Pct. 20+	−0.10**	0.34***	−0.24**
	(0.04)	(0.09)	(0.10)
n		4.5M	

Notes. Dependent variable: An indicator of the specified award type: Definitive contracts are in specification (1), Purchase Orders in specification (2), and Delivery Orders in specification (3). In addition to the tabulated regressors, each specification includes the log of the number of original contacts in 55 product/service groups, product/service fixed effects, agency fixed effects and trends, and year fixed effects. The full sample includes contracts from 32 agencies over up to six years (2005–2010). Standard errors, in parenthesis, are clustered by agency-year. *, **, *** represent significance at the 0.10, 0.05, and 0.01 levels, respectively.

Although this substitution among award types is not formally explored in the model, we believe it is consistent in spirit. If we think about delivery orders as starting off with a partially written contract and simply filling in the details, their use might be particularly attractive to a heavily burdened contracting officer, relative to a definitive contract that he would need to write from scratch and award independently.

For contracts in Iraq and Afghanistan, the case that brought this issue to the front of the policy debate, we actually found very little. Certainly, there was no significant difference in the use of definitive contracts as workload changed. There may be some substitution toward delivery orders and away from purchase orders as workload increases, but the estimates were not statistically significant. We conclude that the case arguing that this sort of substitution is particularly rampant for contracts performed in Iraq and Afghanistan is weak. On the contrary, our data suggest that it is a general fact about contracting and, if anything, is less evident for contracts in Iraq and Afghanistan.

Conclusion

This paper has explored how the variation in contracting officer workload in the DoD is related to contractual outcomes. We found evidence that higher workloads induce contracting officers to write less complete contracts. This reduction in contractual completeness increases the probability of modification, so contracting officers are less likely to award contracts through full-and-open competition. Contrary to theoretical predictions, we found a positive relationship between workload and the use of fixed-price contracts. Some of this relationship between workload may be attributable to the combination of sole-source environments and the Truth in Negotiations Acts that mitigate the advantages of fixed-price contracts over more flexible cost-plus contracts. Finally, we found that when workload is high, contracting officers are more likely to make calls on existing indefinite-delivery vehicles rather than write and award new definitive contracts. With the exception of pricing terms, our results square directly with the parallel analysis of civilian contracting offices in Warren (2012).

This paper also addressed a pressing policy question about the drivers of sub-optimal procurement outcomes in Iraq and Afghanistan contracts. We found that decreasing workload increases the use of competition, increases the probability and frequency of renegotiation, and reduces the initial and final price paid. However, with the exception of competition, the effect of workload is more important for contracts procured outside of Iraq and Afghanistan.

Moreover, in contrast to the conclusion of the Commission on Wartime Contracting in Iraq and Afghanistan (2011), we did not find significant evidence that higher workload causes contracting officers to prefer indefinite-delivery vehicles over definitive contracts. Our results suggest that increases in the size of the acquisitions workforce will affect domestic procurement at least as much as it will affect procurement in Iraq and Afghanistan.

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Acknowledgments

I'm appreciative to my colleagues Ricard Gil, Edward Keating, and David McNicol and to participants at the 2011 WEA Defense Economics sessions for useful feedback. This material is based upon work supported by the Naval Postgraduate School Acquisition Research Program under Grant No. N00244-11-1-0025.

Appendix

Table 10. Agencies in Sample

Agency Name	Pct. Purch	Pct. Deliv.	Pct. Def.	I or A Contracts.	Contracts	C. Off.
U.S. AF, Europe	48.2	48.9	2.9	11	22, 809	55
Air Education and Training Command	39.2	57.2	3.6	106	46, 169	350
Headquarters, Air Force Reserve	30.5	61.1	8.4	0	6, 776	102
Pacific Air Forces	35.4	62.0	2.6	0	22, 805	93
Air Combat Command	38.2	57.0	4.8	0	33, 456	298
Air Force Materiel Command	32.1	58.7	9.2	357	157, 565	2455
Space Command	24.8	68.4	6.8	0	19, 139	540
Air Force, District of Washington	27.4	65.7	6.9	4	6, 678	60
U.S. Army Contracting Agency	39.7	55.4	4.8	391	285, 409	1351
U.S. Army Acquisition Support Center	66.3	15.8	17.9	43, 775	43, 776	256
U.S. Army Corps of Engineers	32.7	61.7	5.7	1, 704	107, 935	846
U.S. Army Medical	56.5	41.2	2.3	1	36, 008	244
Army National Guard Units	41.0	56.3	2.7	1	95, 487	263
Space and Missile Defense	15.3	58.7	26.0	4	3, 106	60
U.S. Army Tank-Automotive	36.1	54.1	9.9	12	50, 487	776
U.S. Army J Munitions	36.9	56.3	6.8	38	4, 489	242
Defense Information Systems Agency	19.9	79.5	0.7	102	49, 382	254
Defense Logistics Agency	25.3	74.0	0.7	204	2, 729, 894	2564
DARPA	12.2	23.6	64.2	0	1, 166	12
Washington Headquarters Services	19.2	67.6	13.2	3	5, 458	36
Missile Defense Agency	5.8	40.6	53.6	0	1, 952	111
Defense Commissary	3.0	96.3	0.7	0	52, 826	95
Defense Threat Reduction Agency	26.9	59.5	13.7	0	2, 912	67
Office of Naval Research	57.5	31.3	11.2	1	23, 460	109
Naval Medical	48.9	50.2	0.9	0	63, 631	105
Naval Air Systems	33.7	54.9	11.3	6	39, 757	539
Naval Supply Systems	50.3	45.4	4.4	10	281, 770	576

Naval Sea Systems	46.4	49.9	3.7	6	88, 467	515
Naval Facilities Engineering	8.8	85.1	6.1	6	100, 438	899
U.S. Marine Corps	42.7	55.1	2.2	49	82, 320	252
Space and Naval Warfare Systems	29.4	68.5	2.1	150	89, 056	201
U.S. Atlantic Fleet	21.4	71.7	6.9	0	11, 694	85

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